Preliminary
High-Level Description of the Electronic Music Distribution System

EMD Document 1.1

UNIVERSAL

Ex cutive Summary

This document describes the anticipated infrastructure for the deployment of the Electronic Music Distribution (EMD). It deals primarily with technical and operational aspects of the EMD: business, marketing, customer and competitive issues are addressed elsewhere.

This document establishes the EMD's high-level requirements, functional and architectural elements and environment. The detailed designs and requirements and specific implementation issues are addressed in lower-level documents.

The supporting EMD architecture should be adaptable, reconfigurable, scalable and offer high quality of service to the users. It should also be open in allowing other distributors to join the system, friendly to use, make it easy to find the musical content, protect intellectual property rights and commercial business rules while allowing complex business models, support a wide variety of information appliances, provide multiple payment options, gracefully maintain service quality during peak demand, and provide on-going compatibility of supporting "legacy" content and players.

The proposed high-level architecture consists of seven modules: Production Systems, Content Catalog, Reference Service, Delivery Service, Retail Web Sites, Consumer Device, Electronic Clearinghouses. This modular design was selected to allow various market participants (e.g., distributors, retailers, CE manufacturers) to maintain their business identity and to build their own modules within the specified interfaces, while ensuring that any module or device build in accordance with the specifications will be able to interact with the rest of the system.

The EMD system will utilize accepted international standards and technologies, such as X.509 for authentication, SSL for secure sessions, DES and triple DES for block encryption, RSA for public key encryption, TCP/IP, HTTP, FTP and SMTP for transport and communication, X.500 for directories, ASN.1 for naming syntax, etc. The EMD Content Distribution Formats will be defined to specifically meet the music industry's needs.

The deployment requirements are broken into three phases: ███████████████████████
███████████████████████████████ The pilot implementation is described in the Appendix, together with the effort and cost estimates.

Revision and Iteration History

Version	Publication date	Authors	Summary of Changes and updates
██████	███████████		████████████████████
██████	████████████		████████████████████

Version note: All intervening versions numbers are internal revisions of the author and not for circulation.

Cont nts

Electronic Music Distribution (EMD) System Requirements

This document describes the anticipated infrastructure for the deployment of the Electronic Music Distribution (EMD). The "EMD infrastructure" is defined as a collection of hardware, system and applications software, networks, operational processes, standards and technologies, protocols, data formats – all the elements essential to delivering the end-to-end EMD service. This is a high-level document (the "top" of the technical documentation tree) establishing the EMD's high-level requirements, functional and architectural elements and environment. The detailed designs and requirements and specific implementation issues are addressed in lower-level documents.

The supporting EMD architecture should meet the "generic" design requirements typical of complex electronic systems. In addition to that, it should meet the requirements specific to the EMD applications.

The "generic" long-term design requirements include:

-       openness and adaptability to change. The system should not be overly dependent on any given vendor or technology. This requires adoption of international standards over proprietary technologies, abstracting applications from the underlying platforms and architecting the infrastructure in a modular fashion as a collection of autonomous services and systems with well-defined interfaces. When proprietary protocols have to be used, they should be encapsulated into standard structures. The messages should carry sufficient information to identify how they should be processed
-       reconfigurability. The system should be designed to handle both short-term changes and medium-to-long term evolution in a transparent fashion, without disrupting the service. It should be possible to add new features with relative ease and at a reasonable cost
-       high quality of service. The system should meet performance requirements of fast and consistent response to interactions. The system should be manageable, reliable and available in a "7 X 24" fashion. There should be no single point of failure for the entire system. The system should employ a highly automated backup/restore strategy
-       scalability. The system should allow for an economic implementation where the system resources are deployed as they are needed. This calls for a highly scalable design, sized up for the initial deployment but capable of expanding by simply adding new elements (e.g., servers, storage) without disrupting the existing operation. For scaling to be effective, all system components – hardware platforms, operating systems, middleware, applications, I/O devices – must be able to scale up to accommodate others
-       practicality. The system should be designed around the reality of the evolving public telecommunications and security infrastructures, using commercial-of-the shelf (COTS) technologies and standard integration and data tools whenever possible

To support the specific EMD applications, as driven by the anticipated business model and deployment plans, the infrastructure should:

-       allow other distributors (besides UMG) to "join" the system. This requires clear definition of the interfaces, non-preferential treatment of the distributors and protection of sensitive information, adoption of global naming conventions, etc. The infrastructure should make the right trade-off between establishing mandatory common elements for cost-effective implementation of user devices while allowing various parties involved to implement their own systems and to protect their business models and business data
-       provide a user-friendly mechanism for acquiring enabling applications software (e.g., downloading the EMD "player")
-       make it easy to find the content. Allow searches both by attributes and by classification

- be able to authenticate, to secure information and to support and enforce commercial rules and intellectual property rights. Support flexible business arrangements and sophisticated rights management, including multi-party offers, complex distribution chains, superdistribution, discounts, pay-per-use, copying and loaning, creation of derivative works, etc.
- allow for a wide variety of information appliances to attach to the infrastructure. The system should support both PC and consumer electronics (CE) platforms, different levels of connectivity (always connected, occasionally connected, never connected), fixed location and nomadic usage, downloadable and pre-packaged media, etc.
- provide and enforce easy, intuitive and consistent naming conventions
- be coordinated with the current UMG business processes and with the evolving UMG business support systems. EMD infrastructure should lend itself to automation of internal business activities
- protect music from piracy and illegal access while keeping these measures within the envelope of a cost-effective CE implementation
- support multiple payment options. Provide financial and usage reporting
- allow for the content to be delivered completely and without errors (the timing of the delivery must be reasonable but might not be as critical)
- allow for the information to be retrieved quickly
- support real-time processing of customer requests via transaction monitoring and workload balancing schemes
- adhere to regulatory environment. The EMD architecture must consider the global implications of data collection, storage, processing, use and distribution. This is particularly true for user data and financial settlements where privacy and taxation laws vary widely
- the reality of the music business is that 1) a small portion of the content usually generates the majority of the demand, and 2) "hits" or promotions can generate significant but temporary "spikes" in demand. Thus, the infrastructure should be designed to accommodate demand variations. This would require 1) a highly distributed architecture where the content is stored in multiple places close to the end users, and 2) ability to send the content to multiple users at the same time. This in turn requires content replication and synchronization and multicasting communications techniques.

In the definition of the EMD system there will be differences between short-term and long-term goals. Not all of the above requirements need to be met in the initial "proof-of-concept" implementation. Instead, the approach will iterative: "try it" based on a rapid application development, test with the users and other parties, and modify based on the stakeholder feedback. One example of this approach is integration of the EMD system with the rest of Universal's business systems. In the long run it is desirable to "seamlessly" integrate EMD with the other processes and systems, e.g., where business affairs and legal negotiate for the EMD rights as a part of their regular negotiation "routine", EMD releases are planned as a part of regular release planning, EMD's digital asset management is a part of the overall company-wide asset management, etc. However, in the short term, the goal is to implement the EMD as a stand-alone operation with well-defined links to the "regular" processes and systems (e.g., the same people who obtain traditional distribution rights will obtain electronic distribution rights, etc.) while laying out a migration path to the long-term goal.

Another critical aspect of the long-term EMD implementation is the required on-going compatibility between the content and the players. As the EMD system becomes operational, it will create a population of the "legacy data" (content) and the "legacy applications" (players). In the connected, "PC world" it is acceptable to expect that the users will periodically upgrade their applications; the new applications rely on the increased memory, storage and processing power to be able to process "legacy" data formats, while the old applications usually can't process the "new" data formats. In the off-line, "CE world" changes in formats are much more expensive and operationally difficult and should happen with much less frequency. The hardware resources in the "CE world" are also limited, making it more difficult for the applications to process multiple formats.

A fully commercial EMD system must address these issues with the objective to 1) minimize situations where players are not compatible with some of the content and vice versa, and 2) design into the system operational processes for replacing or upgrading "legacy" players and content for both on-line and off-line devices. Although the on-going compatibility will not be required in the early stages of the EMD, there will be a time-point where it becomes a requirement to determine a suitable strategy for the upgrading of content and the players. In the immediate deployment of CE devises, they may be restricted to only playing fully paid content based on a reduced set of rights (as with current media), using such schemes as CSS2.
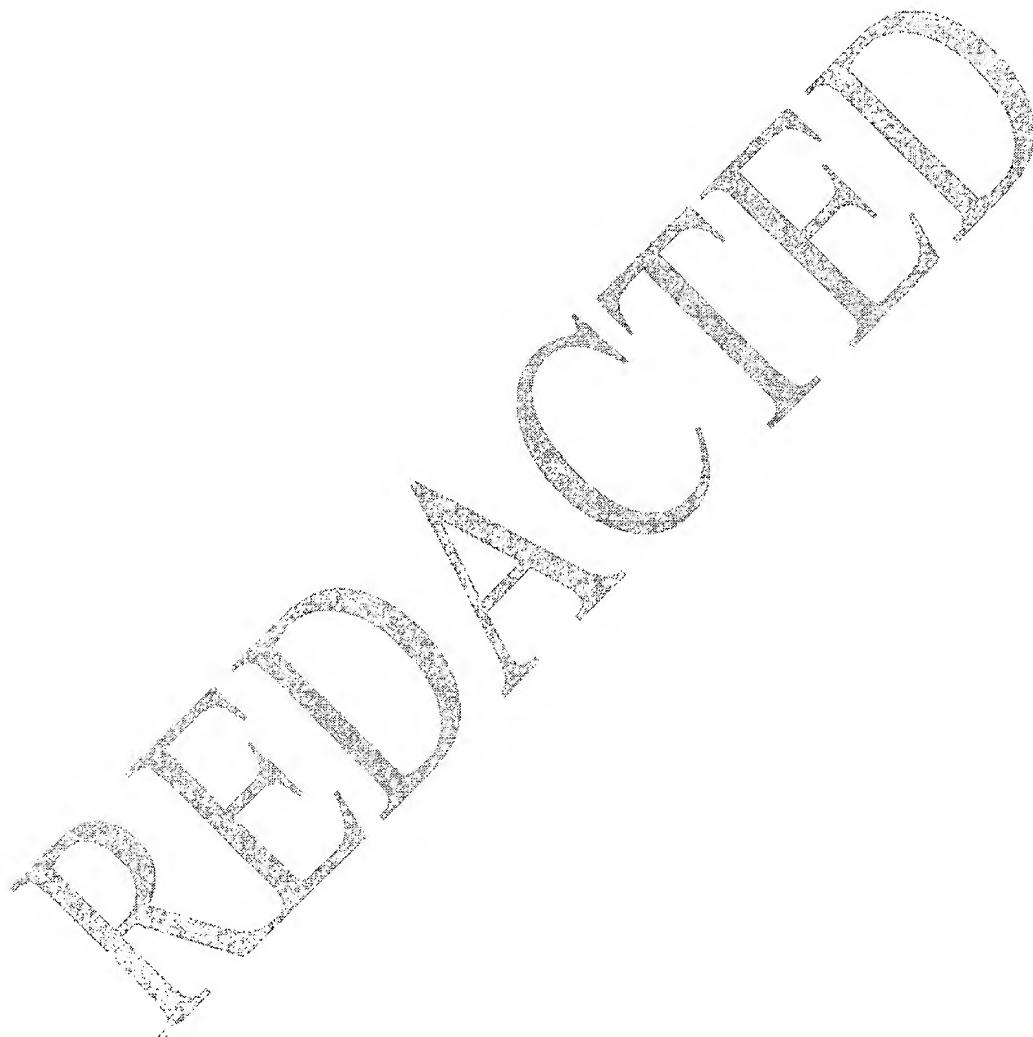
High-L v l Conceptual Architecture

Architectural Components

The provision of an EMD architecture has four essential elements of focus:

- management of the digital assets
- secure delivery of the content
- finding the content
- tracking of usage and provision of financial settlements

These elements are instantiated in the form of seven modules as illustrated in Diagram 1 below. These modules comprise the high-level functional architecture of the EMD service for the PC platform. Each of the architectural modules is defined to perform a specific set of related functions while communicating with other modules through specified standard interfaces. The definition of these interfaces enables the overall development to be broken down into manageable parallel development of the individual modules. The modules will be defined such that multiple implementations of each of the modules can be supported within the standard interfaces.
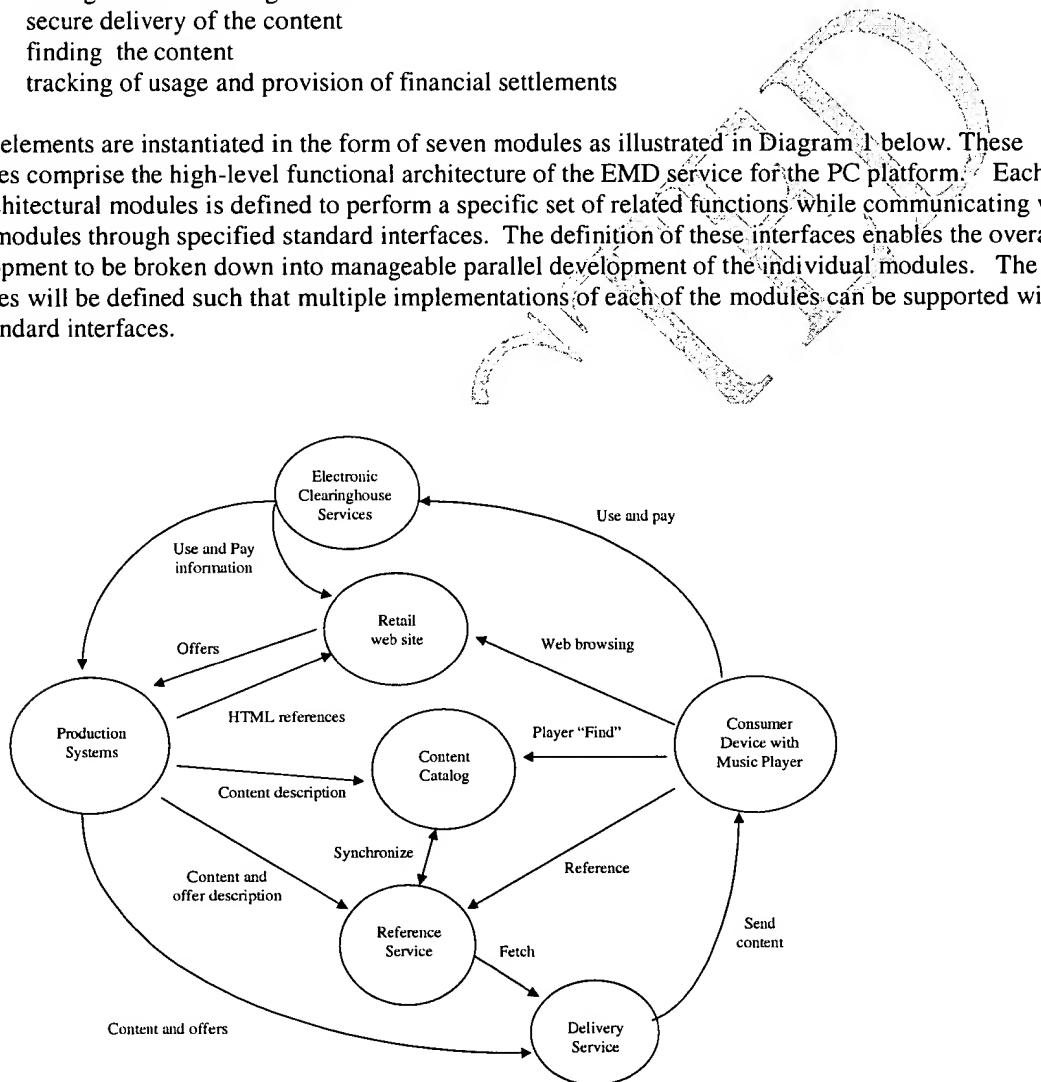

Diagram 1. High-Level Functional Architecture for PC Platform

Each of the seven modules is defined below:

- Production Systems perform largely back-office tasks of populating the EMD service with content and associated commercial offers (rights).
- Retail Web Sites are the "regular" web sites of the music retailers who signed up for the EMD service. They provide retail commercial offers (rights) for the EMD content and can be accessed by consumers via regular web browsers ███████████████████████
- Content Catalog is a combination of "White" and "Yellow Pages" for the EMD content. It is optimized for quickly finding the content based on a constrained set of attributes and can be accessed only via a specialized "player".
- Reference Service helps customers to purchase the content by linking it with valid commercial offers.
- Delivery Service downloads the actual content and associated rights to consumer devices.
- Electronic Clearinghouse Services manage the actual purchasing process by payment processing and collecting usage and survey information.
- "Consumer Device with the EMD Player" enables customers to interact with the system, to download, store, purchase and consume the content while enforcing the business rules.

Summary of Systems Operations

The combination of these modules and the relationships and between the interfaces form the basis for the overall operation of the EMD system. The high level process for creation and consumption of the content is outlined below.

The *Production Service* will prepare content for electronic distribution by packaging content and associated rights into defined secure containers. The *Retailers* will add, or have added on their behalf, their commercial business rules, usually a margin, for the consumption of the content. The resulting content objects will be "staged" in the distribution infrastructure for delivery via the *Delivery Service*. The *Retailers* will place the offer description and the appropriate HTML reference on their web sites for access by the consumer. The *Content Catalog* will have the content object description in its directory whilst the *Reference Service* will have description of the content, its associated rights and retail references in its directories. The *Delivery Service* will have the actual content objects and their encapsulated rights in its databases.

The consumer who has downloaded and activated the specialized EMD software (the "player" including the Rights Management Software or RMS) on finding an offer at a retail web site, will select the offer by "clicking" on it. This will transparently message the Reference Service to validate the offer and, subsequent to the validation, the Reference Service will instruct the Delivery Service to commence the download of the content and encapsulated rights to the user's "player". When the user consumes the content, its player will interact with the Rights Management Software and with the appropriate Electronic Clearinghouse Service to enable the transaction. The user can also get the content by searching the Content Catalog using the player "find" function, from another user (superdistribution) or by acquiring it on a portable media (e.g., a DVD disk) via a physical retail outlet. The distribution methods can be different for different platforms. For example, unconnected CE players will only be able to process content on a portable media with the rights which don't require electronic connectivity.

Multiple Distributors

The initial deployment of the EMD system is envisaged as having a single distributor, though the architecture of the EMD system must be able to support a number of suppliers of content and well as a diverse range of consumption methods and models. Diagram 2 illustrates how the EMD service can be

implemented with two service providers (e.g., distributors). This is extensible to support the current industry and future industry growth and diversity.
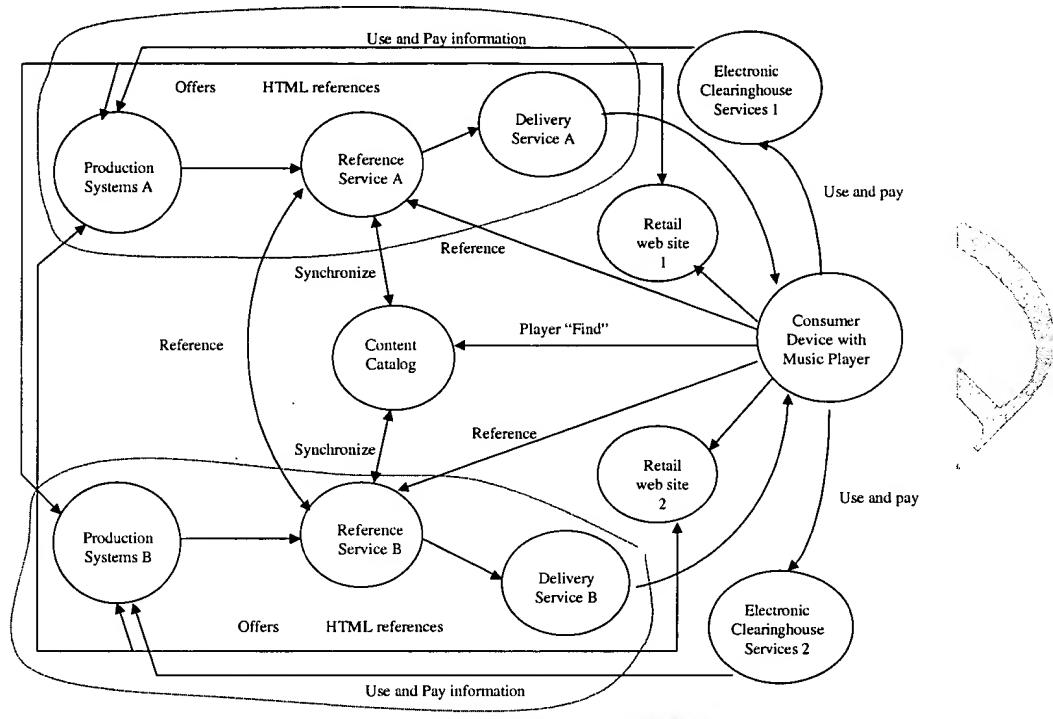

Diagram 2.   Illustrative EMD Service Architecture with Two Distributors

The two service providers shown in the diagram – Distributor A and Distributor B – each have their own Production Systems, Reference Services and Delivery Services. The Content Catalog is common to both providers (i.e., it has information about available EMD content from both Distributor A and Distributor B). Each of the two retailers shown – Retailer 1 and Retailer 2 – signed up with both distributors and offers content from both. Two electronic clearinghouses are shown, one for each distributor. The structure is transparent to the consumer for whom the process of finding, retrieving and purchasing electronic content is the same whether the offered content originated with Distributor A, Distributor B or even a combination of both. Additional distributors can be added to the architecture in a modular fashion. Different arrangements are possible and can be negotiated between distributors, e.g., Distributor C may have its own Production Systems and Reference Service but purchase delivery services from Distributor A. Implementation of the modules is left to service providers subject to a set of rules designed to ensure interoperability:

- service provider has to comply with the specified information model to enable proper operation of the consumer media player
- service provider has to comply with the minimum mandated set of the security and Intellectual Property (IP) protection requirements
- the Delivery Service has to comply with the appropriate player's interface to ensure that content is downloaded and processed in an identical fashion regardless of its origination
- service provider has to supply information about its content to the Content Catalog in a specified format and support information synchronization between the Content Catalog and its Reference Service

- service provider has to support information exchange between Reference Services in a specified format to enable retail offers which aggregate content from multiple distributors
- electronic clearinghouses have to comply with the appropriate media player's interfaces to ensure that the content's usage and payment information is processed in an identical fashion. Electronic clearinghouses may be required to exchange the EMD-related information (e.g., to enable retail offers which aggregate content from multiple distributors).
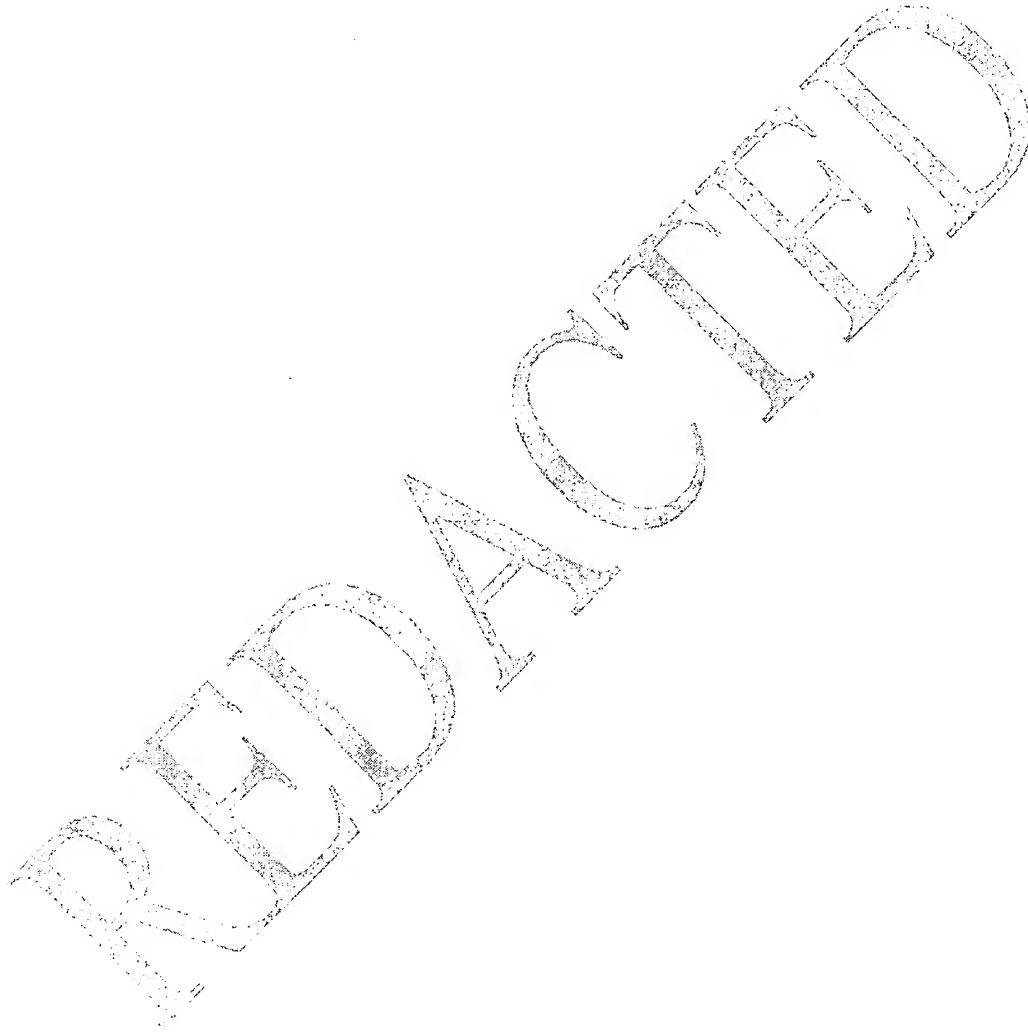
Enabling Standards and Technologies

The deployment of a successful EMD strategy will involve a number of standards and technologies. This section provides some high-level guidelines for the more important standards and technologies which are anticipated for usage in the EMD system.

Security

The EMD system has to protect both the Intellectual Property (IP) content and the rights governing transactions for that content. There are a number of enabling technologies and measures which can be applied to securing electronic commerce. The EMD system specifications shall provide the framework and the policy for implementing security measures within which different technologies can be used as necessary. A trade-off must be achieved between providing enough security to sufficiently protect music from piracy and illegal access while keeping the overall system user-friendly and implementable at a reasonable cost. For example, it is anticipated that all the rights information will be encrypted, but only some of the actual music content (enough to make it "unusable"). The details of this trade-off will be continuously evaluated and iterated as we progress through design and testing. It is anticipated that the EMD participants (i.e., the distributors) will have to comply with a common set of security technologies to keep the complexity of user devices at a reasonable level.

Some of the security mechanisms anticipated in the EMD include:

- cryptographically secured message structures
- protected storage and processing
- authentication schemes (certificates, signatures, tokens, public key systems)
- physical security measures (e.g., passwords)
- watermarking of the content
- transactional watermarking
- tamper-resistance

The EMD security policy may include the following (as an example):

- production systems protected by firewalls, passwords, etc.
- all intellectual property content outside of the production systems (i.e., on the internet) is cryptographically secured
- all messages involving movement of financial information or intellectual property are cryptographically secured
- cryptographic key management system with periodic key changes
- changes/upgrades of the rights management software
- all the EMD clients must be authenticated for every financial transaction
- all the EMD clients allowed to download content must have protected storage and processing mechanisms-
- certification of the interfacing applications and limitations on the interaction with non-certified applications software
- rights management software and hardware is tamper-resistant
- all the content is watermarked.

Examples of the standards and technologies which will be considered for inclusion in the EMD are:

- ███████████████████████████████████

███████████████████████████████████████

For more detailed discussion please see EMD Documents 1.1.1, 1.2, 1.3.1, 1.3.3, 1.4.3.

Transactions and Payments

The EMD system will not mandate any single electronic transaction and payment system. Instead, the details of the transaction and payment functionality will be abstracted out of the system. Any clearinghouse wishing to participate in the EMD will have to comply with the information formats and the reporting and security requirements. Clearinghouses will be required to support multiple electronic payment mechanisms, such as online credit card payment, ██████████, etc. Transaction aggregation mechanisms need to be supported.

For more detailed discussion please see EMD Documents 1.5.1 and 1.5.2.

Transport and Communication

For data transport and communication the EMD system will utilize the existing internet standards, such as TCP/IP, FTP, HTTP, SMTP, etc. Any specialized or proprietary data structures will be encapsulated within these standard protocols.

For more detailed discussion please see EMD Documents 1.1.1, 1.2.

Naming Services and Directories

It is mandatory that in order to achieve interoperability the EMD participants will adhere to the agreed-upon global naming conventions. The current music industry ID tags (e.g., the ISRC codes) are not sufficient to meet the EMD requirements. While there are some developments in creating object identification systems in other industries (e.g., DOI for publishing), presently there is no standard global naming convention for the music industry. The EMD system will require an attribute-based name service capable of resolving both precisely known object names and imprecise queries. The EMD system will also require that the information be organized in directories in a way that allows fast search performance, provides storage integrity, scaleability, replication and access control.

It is proposed that the EMD use the X.500 Directory Service – defined by the CCITT and ISO standards organizations as an Application Level service in the Open Systems Interconnection (OSI) set of standards – to meet these requirements. The EMD's X.500-based Directory Information Base (DIB) will be organized in a tree structure with named nodes and a range of content attributes stored at each node. All objects will be classified by type defined according to the ASN.1 syntax notation. The object types and attributes will be defined specifically to match the EMD content and operations needs. This approach will allow the EMD system to take advantage of the emerging trends in the networking and information management (such as Directory-Enabled Networking (DEN), X.500 and its subset LDAP) and leverage the standard integration and data tools, while creating a system custom-fit for the EMD needs.

The X.500 directory structure will be implemented via an industrial X.500 directory system product which will be overlayed over database platforms. It will be mandatory that all the EMD-participated systems support X.500 or, at least, the LDAP protocol.

The following CCITT standards will employed for the EMD directories:

-   X.501   The Directory – Models
-   X.518   The Directory – Procedures for Distributed Operation
-   X.519   The Directory - Protocol Specification
-   X.525   The Directory – Replication

The LDAP Specification will have to be supported by the organizations not implementing the X.500 protocols.

For more detailed discussion please see EMD Document 1.1.1.

Databases

The EMD system does not mandate database systems, products or vendors. However, it is necessary for distributors to choose industrial strengths solutions with high performance, reliability, scalability and replication capabilities. Thus, it is expected that commercial, well-proven DBMS's will be utilized. Furthermore, it is expected (but not mandated) that either relational or object-oriented DBMS's will be employed.

For more detailed discussion please see EMD Documents 1.1.1, 1.2.

Multimedia

Given continual change in this industry, the EMD system has to be flexible with respect to the multimedia standards. Different standards and formats will be defined in object attributes, and additional ones can be added as needed. Since objects with encapsulated content will carry information about the content's format(s), a player compatible with the specified format(s) will be able to process the content.

The activities of the MPEG 4 group will be closely monitored and the EMD system will be aligned to this emerging standard as it develops.

For more detailed discussion please see EMD Documents 1.3.1, 1.4.1, 1.4.2.

Integration Technologies

The challenges of building a large, distributed complex information system such as EMD and integrating it with the existing "legacy" operations can be addressed by dividing the system into manageable elements that interact to form complete applications. It is anticipated that integration of distributed components will be achieved via so-called "middleware" products. There are two general middleware categories – Transaction Processing (TP) managers and CORBA-based Object Request Brokers (ORB) – which are increasingly converging. CORBA-based solutions should be evaluated based on their compliance with the Object Management Group (OMG) Object Transaction Services definition.

Network Management

The network management tools should as a minimum support Simple Network Management Protocol (SNMP)-compatible agents in the various hardware and software components, based on a Management Information Base (MIB) interface definition. These will be complimented by Enterprise management systems that provide a method for managing the operation of a widely distributed system.

D scription of Architectural Modul s

Within the overall architecture the individual modules are outlined below. Note that the initial architecture is targeted towards a connected user with a PC-based platform. Other devices (e.g., an unconnected CE player) can be implemented as constrained subsets of the described service.

Production Systems

This module provides processing, labeling and packaging of the content and associated business rules into the formats suitable for storage and distribution on the Internet. There can be multiple Production Systems modules (e.g., one for each participating distributor). The Production Systems module will interface to the internal business processes and systems. Within the EMD architecture, the Production Systems will populate the Distribution Infrastructure (including the Content Catalog, the Reference Service, and the Delivery Service) with the secured content and the offers (rights) for purchasing this content. The Production Systems module will be protected, allowing only authorized access from the rest of the Internet (e.g., by a firewall). It is currently anticipated that only "secured" Intellectual Property will be allowed to exist outside of this module.

The Production Systems will also interface to the Retailers Web Sites for providing information about the content availability and receiving associated retail offers. Initially, the Production Systems will also interface to the Electronic Clearinghouse Services for payments and usage information; eventually, this interface will be migrated directly into the internal Business Operations Support Systems.

The Production Systems will be the part of the EMD most directly interfacing to the other internal processes and systems. Combination of the Production Systems, their processes and the internal systems and processes involved is referred to as the "Back-Office Systems".

For more detailed discussion please see EMD Documents 1.4, 1.4.1, 1.4.2, 1.4.3.

Retail Web Sites

This will be usually be the first point of contact with the user, where they have located a retailer's web server and downloaded the page containing the reference to the content, including the retailer's purchase offer. Customers will perform this operation using their Web Browsers. All actions upon selecting this reference will then be transparent to the Retail Web Sites. The Retail sites will interface with the Production Systems module to receive information about available content and provide associated retail offers. Upon receiving the offer, the Production System module will return to the retailer's web server the appropriate HTML reference which will be unique to that particular offer. In the future some Retail Sites may elect to process and create the HTML references internally and communicate them back to the Production Systems modules.

For more detailed discussion please see EMD Documents 1.2.1, 1.4.3.2.

Content Catalog

The Content Catalog module contains information about all the content available for the EMD distribution and "registered" with the Catalog. The Content Catalog will be "open" to all the content providers compliant with the applicable standards and naming conventions. The Catalog will be populated by the content descriptions from all the EMD-participating Production Systems.

Consumers will query the Catalog via the "Find" function of the Universal Media Player (UMP). When queried, the Content Catalog will return to the consumer a list of the content matching the search criteria. The operation will be similar to the "Search" function of a typical Web Browser ███████████████ performed on a Web catalog site ████████. However, instead of returning literally thousands of relevant entries, the Content Catalog will return a short list of the content matching the search criteria and available for the EMD distribution. The Catalog will not keep track of the commercial offers associated with the content nor of the content's storage location. Instead, each of the returned entries will refer customers to the appropriate Reference Service (usually associated with a distributor) which can resolve the reference into commercial offers and the actual content storage location(s).

For more detailed discussion please see EMD Document 1.2.3.

Reference Service

This module resolves references to the content and the associated commercial offers. There can be multiple Reference Service modules (e.g., one for each participating distributor), each handling only the content and the offers assigned to it. This would allow distributors to maintain an effective operational control over packaging and purchasing of the content they distribute. The Reference Service module receives reference requests from the users, based on a reference from either 1) a Retail Web Site, or 2) a result from a Content Catalog search, or 3) a secured content being distributed directly by the consumers (i.e., super-distribution). References from retailer's sites and from super-distribution will usually identify the content and the offer uniquely. In this case the Reference Service will verify that the offer is valid and pass the content request to the Delivery Service module. If the offer is not valid (e.g., it expired or relationship with that retailer has been terminated), the Reference Service module will provide the customer with valid offer(s) based on certain business rules. The Reference Service will function similarly when responding to a reference based on a Content Catalog search – since the search results will not provide actual commercial offers, the Reference Service will provide the customer with commercial offers based on the content being requested and its business rules. The Reference Service will be populated by the descriptions of content and associated commercial offers and by the business rules from all the Production Systems assigned to that Reference Service (e.g., from the same distributorship).

For more detailed discussion please see EMD Document 1.2.2.

Delivery Service

This module receives and stores the actual secured content and offers from the associated Production Systems. It also receives requests from the Reference Service to send content to the users and delivers secured content to the consumers. The primary function of the Delivery Service is storage- and communication-oriented – retrieve and transmit the content quickly and without errors.

Within this function is also the need to be able to guarantee a quality of service (QOS) to a customer. This allocation of service bandwidth may be based on the emerging standards such as RSVP or may involve premium provision in conjunction with ISP's or other bandwidth providers. As discussed later in the document, the Delivery Service is a logical candidate for outsourcing to an internet services provider.

For more detailed discussion please see EMD Document 1.2.4.

Electronic Clearinghouse Services

These modules will provide the mechanism for the user to access the secured content by transacting for the appropriate rights. They will collect information on usage and transactions, which may include surveys and

other non-financial information sets. The Clearinghouse Services will interface with the users, with retail sites and with the internal business systems of content providers (initially the Production Systems module). Interfaces to the Clearinghouse Services module will be defined using emerging electronic commerce standards rather than proprietary protocols, to enable usage of any clearinghouse service compliant with these standards.

For more detailed discussion please see EMD Documents 1.5.1, 1.5.2.

Content Consumer

Content is consumed by our customers using the Universal Media Player (UMP) or a UMP-compatible player on a suitable host, initially the Wintel PC, eventually various Consumer Electronics (CE) devices. The key components of the UMP are:

- Rights Management Software (RMS) – a virtual machine that manages the user's rights to operate on the content
- Protected Rights Database (PDB) – a secure storage of user-acquired rights being managed by the RMS
- Content Database – a storage facility for secured acquired content
- Electronic Commerce Module (ECM) – manages user accounts, budgets, payment history
- Controller – manages memory, media players, associations, events scheduling, installation
- Editor – manages lists and associations
- Viewer GUI – manages user interface.

In order to be able to download content from the EMD, the player needs to be supplemented with a communications device (phone modem, cable modem, etc).

For more detailed discussion please see EMD Documents 1.3.1, 1.3.2, 1.3.3, 1.3.4.

Deployment Manager

The Deployment Management function is one of key elements of the supporting infrastructure. The Deployment Manager will provide the user with the UMP, after which the user will be able to undertake transactions and gain access to the content. The Deployment Manager will also "cancel" user's devices as needed to lock the "unwanted" users out of the system.

The Deployment Manager will also undertake the registration process of the initial clearinghouse function and is key element in authenticating the identity of the user and the location of any Rights Management System██████████████.

Supporting Functions

While not shown on the architectural diagram, the EMD service needs to be supported by an operational infrastructure. Support will need to be provided for the EMD customers, some special UMP applications (e.g., e-mail, buddy list) and for developers enhancing the EMD. Network management and customer care facilities will be needed for the EMD operations.

For more detailed discussion please see EMD Documents 1.6, 1.6.1, 1.6.2, 1.7.

Data Architecture

The EMD design will provide an environment in which the content published on the Internet can be leveraged into enhanced commercial and other interactions between content providers and content consumers. The knowledge about content, artists, users, etc., will be structured using uniform object-oriented modeling formalisms derived from standard specifications.

The information model consists of a schema for defining objects and rules governing how objects interact with each other. It is proposed here to utilize the information modeling principles drawn from the X.500 series of international standards. A common namespace will be promoted to ensure that applications developed by different vendors can inter-operate with each other.

All the EMD messages should be compliant with the EMD Content Distribution Format (CDF) described in the document EMD-1.1.1. The high-level structure of the EMD messages is defined as follows:

Field	Content
Header	Identifiers, object class and sub-class
Signature	Authenticates message originator
Business rules	Business attributes pertaining to the content
Security-recipient	Decryption information for individual recipients
Distribution information	Message processing information
Content description	Content attributes
Rendition information	Playing/media attributes
Extension information	Pointers to extension objects
Encapsulated content	Secured content; proprietary distribution structures

The Header is the mandatory field for all object classes. Other fields can be mandatory or optional depending on the object's class.

The main types of object classes are:

Track - a single distinct unit of content which can be transacted upon (e.g., a song)
Group - a combination of tracks (e.g., an album or a collection of tracks bound together by business rules)
Content Description – description of content attributes of a track or a group
Business Rules - description of business attributes pertaining to a track or a group
Rendition – description of playing/media attributes pertaining to a track or a group.

The information (object classes) is distributed among various architectural modules as follows:

Architectural Module	Information (object classes)
Content Catalog	Content Description for tracks and groups for all EMD content
Reference Service	Content Description and Business Rules for tracks and groups for all content from a particular distributor; HTML references
Delivery Service	Tracks, Groups, Content Description, Business Rules and Renditions for all content from a particular distributor
Consumer Device	Tracks, Groups, Content Description, Business Rules and Renditions for all content downloaded by the particular consumer
Retail Web Sites	HTML references

Objects will be bound together in secure persistent containers to form the basis of content and rights distribution in the EMD. For example, two tracks can be combined in the same container with a business

rule "purchase each track for $1 or two tracks for $1.50" and the combined object can be safely (from the Intellectual Property perspective) distributed on the Internet.

Information-wise, the EMD is envisioned as a Directory-Enabled Network (DEN), consisting of X.500 – compliant object-oriented distributed directories. This would allow fast and consistent searches across the entire EMD system.

For more detailed discussion please see EMD Document 1.1.1.
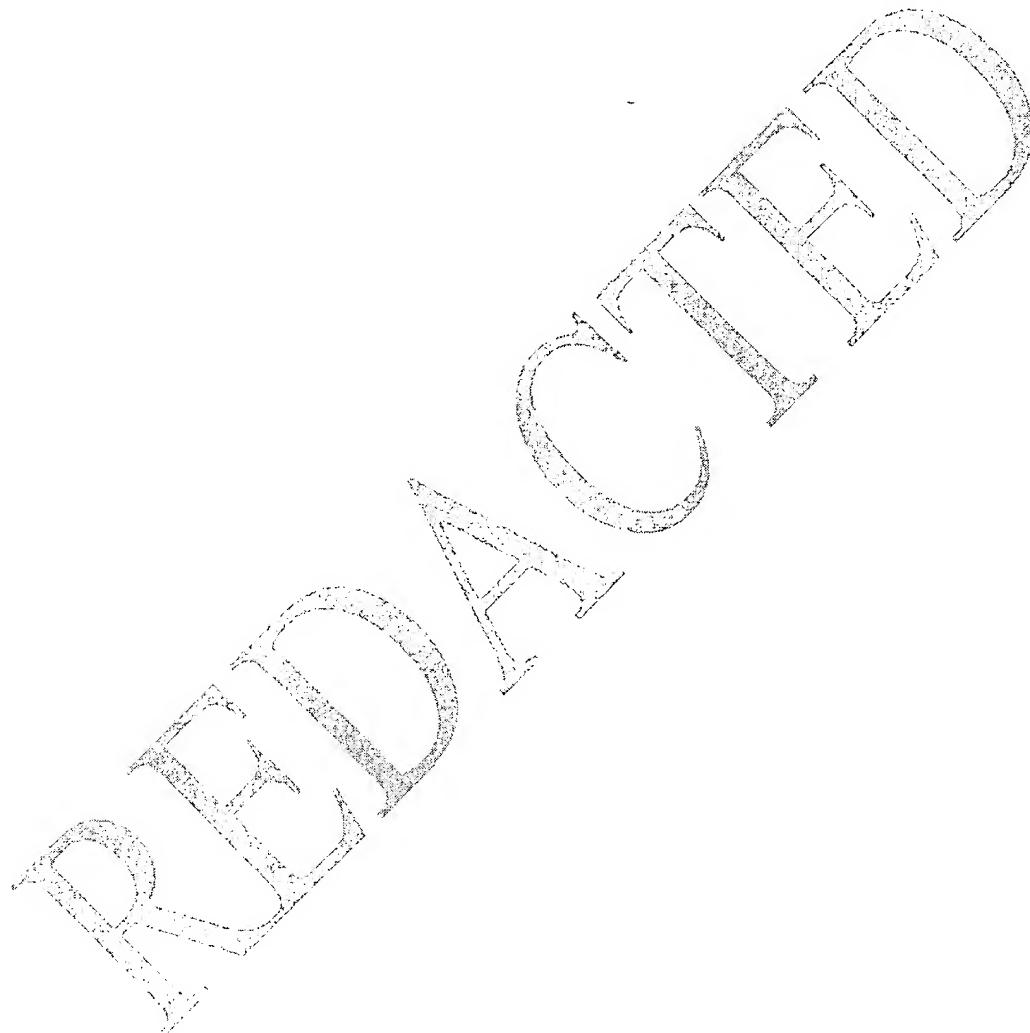
N twork Archit cture

This section provides high-level networking assumptions about how the EMD system modules are configured (e.g., distributed vs. centralized) and interconnected. This is a strictly an architectural perspective not providing recommendations or solutions.

Content Catalog

It is currently assumed that the Content Catalog (CC) is a separate physical and logical entity providing directory services of available EMD content for all the participating content distributors. There will be a single global CC for the EMD system (although its instance can be replicated as necessary). Its information store is formed by the participating organizations sending it content description objects. It is in the content providers' interest to participate in the CC as this will increase their sales. To ensure that the CC searches are objective (i.e., give no preference to any party), it is assumed that the CC will be run by a "trusted party" such as IFPI. It is assumed that the CC will receive its content from the Production Systems of the participating distributors and will synchronize its directory with the Reference Services of those distributors, although other implementations are possible subject to more detailed design considerations.

Reference Service

It is assumed that a given Reference Service (RS) provides directory services of available EMD content and associated commercial offers for one distributor only (i.e., each EMD-participating content distributor will have its own RS). To improve performance, distributors may choose to replicate the instances of their RS as necessary. RS's from different distributors will communicate with each other to enable retail offers which combine products from different distributors. It is assumed that this communication will be directly RS-to-RS (alternatively, it can be via the Content Catalog, RS-CC-RS). It is also assumed that each RS will receive its content from the Production Systems of the given distributor and will synchronize its directory with the Content Catalog.

Delivery Service

A given Delivery Service (DS) will provide fulfillment function (downloading of the content and rights objects to the users) for one distributor only. There might be multiple DS's per distributor – e.g., one per label. It is assumed that to provide the required performance each DS will be physically distributed and replicated across multiple locations governed by a Resource Manager. It is also assumed that each will receive its content from the Production Systems of the given distributor.

Due to the anticipated highly distributed nature of the DS (with server farms positioned in multiple locations), it is a logical candidate for outsourcing to one of the major providers of web site hosting services. If the outsourcing strategy is pursued, the candidates should be evaluated on such criteria as 1) server farms available in most large metro areas, 2) cost-effective services, 3) strong network operations capabilities with established processes and escalation procedures, backup and emergency recovery, 4) reliable, high-speed backbone, 5) good security measures (firewalls, monitoring, physical access), 6) support of different levels of performance, and 7) direct connections to all major ISP's and NAPs.

Production Systems

Production Systems belong to content distributors. It is their decision on how to centralize or distribute this function. It is assumed that initially, while the volume of EMD content is relatively small, there will be only one Production System per distributor. It is also assumed that the Production Systems will coordinate the offers with the Retail Web Sites and will supply all the EMD objects to the distribution infrastructure, including the Content Catalog and the Reference and Delivery Services of this distributor.

Retail Web Sites

Retail Web Sites belong to the retailers. It is their decision on how to centralize or distribute this function. It is assumed that the Retail Web Sites will coordinate their offers with the Production Systems of participating distributors and will receive from them the appropriate HTML references.

Clearinghouses

Clearinghouses will have to be "certified" in order to participate in the EMD system. There is no restriction on the number of clearinghouses which can participate in the EMD system. Practically, it is assumed that there will be one clearinghouse for each large distributor. It is anticipated that the economic forces will probably drive to a small number of players in the clearing business.

Supporting Operational Infrastructure

There will be a number of EMD system functions designed to enable and enhance user experience, such as the Deployment Manager to download the player, E-mail and Chat/Buddy Servers for interaction with other users and artists, etc. This infrastructure should be transparent to the user, i.e., he/she should not have to sign up with multiple mail services. It is assumed here that E-mail and Chat/Buddy service functions will be centralized, perhaps physically associated with the Content Catalog. The Deployment Manager functions may be physically associated with Clearinghouses. The Customer Care function will include both telephonic and on-line customer support. The Network Management fuention should provide system-wide, integrated view of the EMD and enable effective trouble management.

Customer Systems

Customers Systems include EMD applications software/hardware and its environment, either PC- or CE-based. There will be a variety of customer devices in the field, some always connected, some connected at times and some never connected.

For more detailed discussion please see EMD Documents 1.2, 1.3, 1.4.

Operational Description and R quir ments

This section summarizes major assumptions about how customers and operational personnel will interact with the system. For more detailed discussion please see EMD Documents 1.2.2.1, 1.3.2, 1.4.2, 1.4.3, 1.6 and, especially, 1.8.

Deployment Operations

Include setting up the Content Catalog, Reference and Delivery Services, Deployment Manager(s), Electronic Clearinghouses and E-mail and other user services. These operations will be subject to strict change management and control procedures. Backup, archive and restore processes will be put in place to ensure reliable operation.

Production Operations

Prior to customer transactions, the EMD system has to be "loaded" with the appropriate content and information. Production Operations include producing the content (the content here is defined broadly, meaning the content itself and its attributes and rights) for EMD distribution, staging content in the Distribution Infrastructure (Content Catalog, Reference Service, Delivery Service). Defining the Reference Process – how the Reference Service resolves imprecise queries – also falls in this category.

Distributor's Production Service (the Production Systems and the people operating it) will format a recording (Track) for electronic distribution. Authorized retailers will be informed that this recording is available for EMD. Retailers log onto the Production Systems via secure extranet and fill out a form specifying their "business rules" for this recording. A rule-based tool will be required to manage offers definition on-line, as specified in the rules table. As the result of this process, the EMD Production Systems create a number of content-associated objects: ContentDescription Object, BusinessRules Object, Rendition Object and Track Object, each with a unique ID. If the Track is also a part of a Group (e.g., an Album), a Track Group object is also defined together with its ContentDescription, BusinessRules and Rendition objects. Production Systems also generate an HTML Reference for each retailer's offer and provide it to the retailer. Additional information (e.g., graphics, text, a portion of a web page) might also be provided. The recording together with the associated objects is secured for the Internet distribution and transferred to the Distribution Infrastructure using defined messaging formats.

By the end of the process different modules of the system have the following information about this Track:

Architectural Module	Information
Content Catalog	ContentDescription object
Reference Service	ContentDescription object, BusinessRules object, HTML reference
Delivery Service	Track object, ContentDescription, Business Rules and Rendition objects
Retail Web Site	HTML reference

Use Operations

This set of scenarios addresses customer's interaction with the EMD system. It includes such functions as downloading the enabling software, establishing transactional account(s), finding and downloading content,

receiving content from other customers, using e-mail, etc. An illustrative brief description of the most common user operations is provided here.

If a customer sees a product (content plus offer) she is interested in on a retail web site, she clicks on the HTML Reference and is taken to the specified (in the HTML Reference) Reference Service. The Reference Service verifies that the request came from an authorized retailer and that the offer is valid and sends a request to its Delivery Service to find the content and the associated objects and to send them to the customer. The Delivery Service checks its database, finds where the content is stored and chooses the server to download the objects. The selected server initiates an ftp session with the UMP. The customer is offered information of the size of the download and the time it will take. The customer will have an option to stop the transfer or to schedule it for a later time. Otherwise, the Track and the associated objects are downloaded to the customer's UMP. When the customer tries to open the content, the protected processing environment application initiates the rights transaction process as the result of which the customer will acquire the rights to the content. The transaction will be logged in the Electronic Clearinghouse Systems.

If the customer initiates a query for recordings by an "artist" via the Find function of the UMP, she is connected to the Content Catalog. The Content Catalog checks its database of ContentDescription objects using the index "artist" and finds and ranks those that meet the criteria. If the customer selects one of the choices offered by the Content Catalog, she is connected to the Reference Service associated with the chosen object. The Reference Service searches the Reference Database for offers which include the selected content and provides the customer with a choice of offers and their brief description. If the customer chooses one of the offers, the Reference Service will send a request to the Delivery Service.

Settlement Operations

Content in the EMD system will be distributed in secure containers with the "rights" (business rules for consuming the content) enclosed. For the most part the transaction for the content will not happen until the user decides to consume the content (although transaction can happen prior to consumption – for example, in case of off-line CE devices the content will be paid for at retail and the "rights" will allow consumption). When consumer decides to use the downloaded content, the EMD player will interact with the Rights Management Software and the user profile to determine how the content can be used and at what price. The system should be capable of calculating transaction charges based on the combination of business rights, user-specific data (e.g., home location, credentials of belonging to a certain group) and usage (e.g., for volume discounts). Periodically, or as dictated by business rules and budget limitations, the EMD player will initiate a session with the Clearinghouse to report the accumulated transactions.

Since each content object is securely bound to its rights, Clearinghouses don't have to know the rights in order to collect the transactional information. However, it might be useful for Clearinghouses to know some of the rights in distribution in order to detect possible tampering attempts.

The Player – Clearinghouse communication requires highly secure environment. The Clearinghouse will interface to the designated financial institutions to report transactions and, if required to authorize a transaction on-line. If necessary, the Clearinghouse will aggregate small transactions for reporting purposes. The Clearinghouse shall have the ability to support multiple exchange rates and provide tax calculations for variable rates and several taxation levels for all jurisdictions which exist within the Clearinghouse's marketing area. The Clearinghouse will maintain extensive audit trails and will be able to initiate customer "cancellation" (via the Deployment Manager) if necessary. The Clearinghouse will produce financial and usage statements and send them to the content distributors in a specified format. It is currently anticipated that the actual customer billing will be provided by financial institutions.

Network Management Operations

System Management Operations

It is assumed that an automated system management tool will be used for on-line monitoring and real-time management of the distributor-wideEMD system and its components. The system management tool should be capable of:

- remote monitoring and management of system's elements with automatic problem detection, alerting and alarm escalation, cause analysis
- automated backup, archive and restore solutions for the key elements of the EMD
- ability to backup in a live continuously available environment
- performance monitoring and asset management
- automating configuration and deployment tasks including global distribution
- automatic preventive and corrective actions and prioritization of action items
- central policy-based configuration
- plugging in 3rd party monitors, etc.

It is assumed that the system management tool will be based on a standard network management protocol, such as SNMP, and that various hardware and software components will be required to be compatible with this standard. It is anticipated that system management use a commercial-off-the-shelf (COTS) product, such as ███████████████████████████ or a combination of them. Although different portions of the EMD system might be outsourced to / implemented by different vendors, there needs to be an integrated, single point of access to the data affecting distributor's network.

Security Policy

EMD deployment requires development of a security policy governing user access to data and applications and designed to protect both the system's integrity and the un-secured content. This will be an administrative task of network operations, including definition of user ID's, groups and roles, assignment of access rights by user or group, audit trails of user and access data, password protection, remote access control, virus checking and removal, etc.

Player Management

Each EMD player and its secure processing environment will be uniquely identified. The EMD system shall maintain database(s) of deployed players, detailing their unique ID's, version, current status, home location, etc. These databases are likely to be located at the Deployment Manager(s) and/or Financial Clearinghouse(s).

Problem Resolution

The EMD system shall have one or more focal points for the reporting and correction of service problems, closely related to network management and customer care functions. All the reported problems will be ticketed and addressed for resolution. Potential COTS products can be considered (e.g., by Vantive, Clarify, Scopus) based on scalability, platform requirements, license fees, trouble tracking, customizable workflow, sales/web interface, API support, etc.

Deploym nt Requirements

This section summarizes major assumptions about sizing, scoping and deployment plans. It defines a high-level roadmap / staged rollout plan showing how EMD development is transformed and rolled out to become a commercial, mass-market EMD system. For more detailed discussion please see EMD Documents 2.1 and 2.2.

Pilot

It is assumed that the EMD pilot ██████████████████████████████. This is largely a "proof-of-concept" testing stage. The purpose of the pilot is to prove some of the technology elements, to test the basic EMD concepts with users and partners, and to support the development. There is no "compatibility" requirement for the pilot (i.e., it can be a "throw away" implementation) and there expected to be multiple upgrades/releases during the pilot itself. The pilot is expected to involve some script-based testing.

The content for the pilot will be limited: initially about 20 albums and 20 singles, growing to 50 albums and 50 singles. The pilot will involve one distributor (UMG), 2-3 retailers, one provider of the distribution infrastructure (one content catalog, one reference server, 1-2 delivery servers), one secure technology provider and one clearinghouse provider.

It is expected that the pilot will utilize the secure containers ██████████████████████
██

The pilot will start with only the basic player functions (find content, download content, purchase content, create an edit list, etc.) and with limited set of content rights (pay-to-own, pay-to-use). The pilot will not use real $$'s.

It is expected that the pilot will start with up to 100 users and will eventually grow to up to 1000 users. Pilot users will be selected to utilize different communications technologies (dial-up, cable modem, DSL).

Appendix A discusses pilot implementation in greater detail.

Limited Commercial Testing

It is assumed that the EMD limited commercial ("beta") testing ████████████████████████
████████. The purpose of the "beta" is to prove the remaining technology elements, to test the more advanced EMD concepts with users and partners, to scale up the system, to prove the system operationally, and to support the on-going commercialization of the EMD technology. There expected to be upgrades during the "beta", but at some point (probably towards later stages) a "compatibility" requirement will be imposed.

The content for the "beta" will be initially about 50 albums and 50 singles, growing to 200 albums and 200 singles. The "beta" may involve more than one distributor, 3-5 retailers, one provider of the distribution infrastructure (one content catalog, two or more reference servers, 5-10 delivery servers, one mail server, one "buddy/chat" server), one secure technology provider and one or more clearinghouse providers.

The "beta" will start with most of the anticipated player functions and with a larger set of content rights. The "beta" will not use real $$'s initially, but may switch towards later stages.

██
██
██████████████████████████████

It is expected that the "beta" will start with up to 1,000 users and will eventually grow to up to 10,000 users. Only PC-based platforms are expected to be utilized.

Commercial Rollout

It is assumed that the EMD commercial rollout will occur right after the "beta" testing ███████. By this time all the technology elements should have been proven and bug-free and the system scaled up for operation with tens of thousands of users. There expected to be upgrades during the system's lifecycle, but they will be subject to the "compatibility" requirement.

The initial content for the commercial rollout is expected to be initially about 250 albums and 250 singles. The commercial rollout is expected to involve multiple distributors and retailers, one or more providers of the distribution infrastructure (one content catalog, two or more reference servers, 10-20 delivery servers, one mail server, one "buddy/chat" server), one or more secure technology providers and one or more clearinghouse providers.
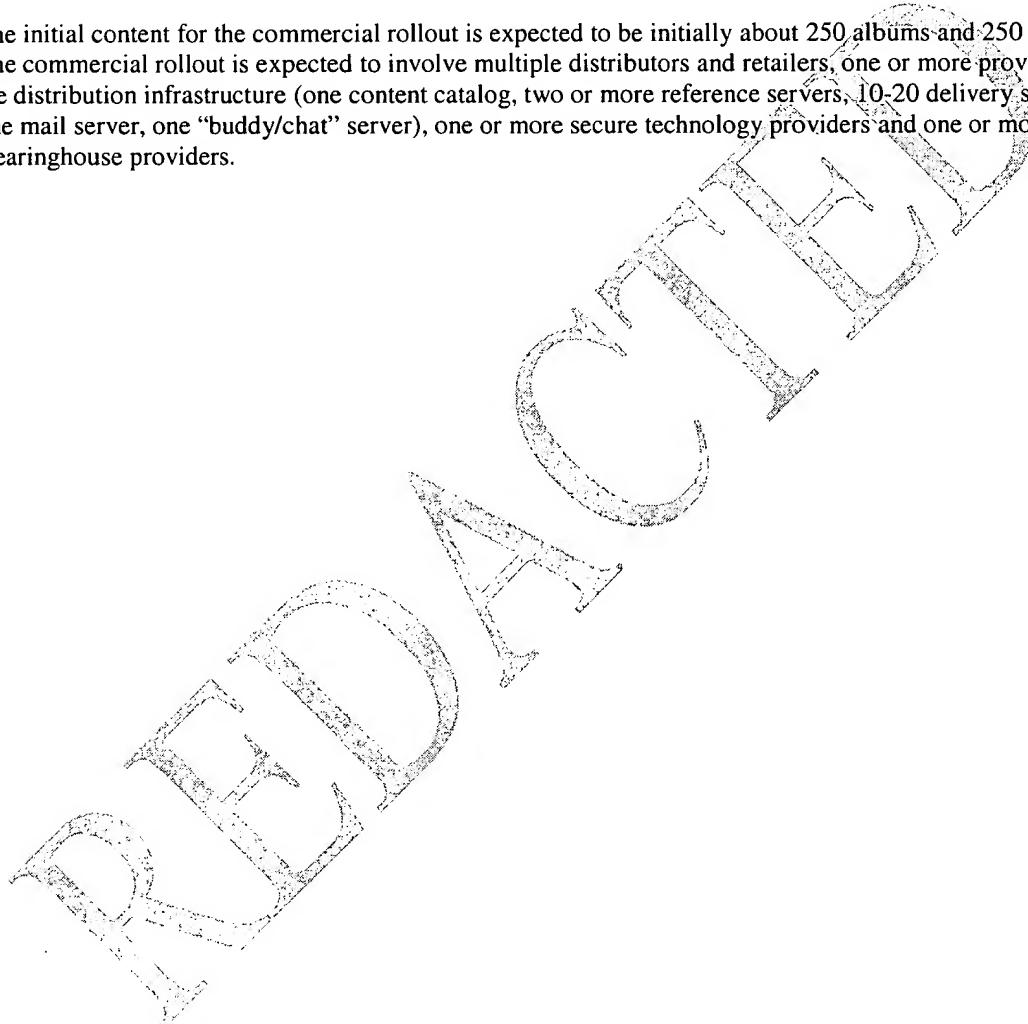
App ndix A: EMD Pilot Implementation

Fig. A1 shows a functional diagram of the suggested EMD pilot.
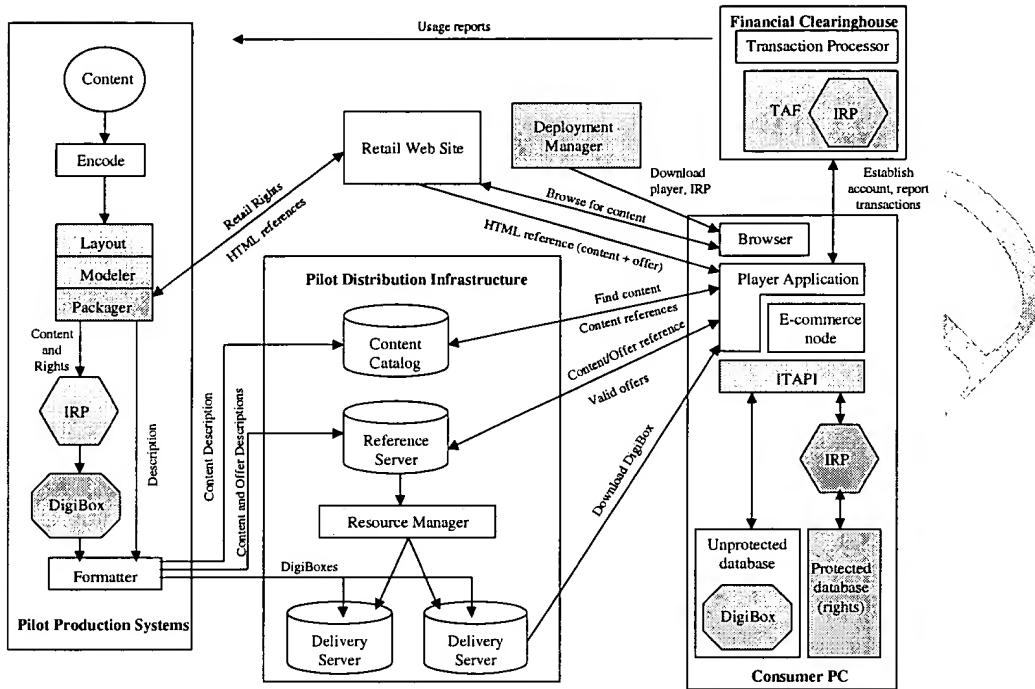
Fig. A1: EMD Pilot Functional Diagram

It is assumed that the pilot will utilize ███████████████████████ offering, the elements of which are shaded in blue and include the ███████████████ the ████████████ the ████████████████████████ the ████████████████, the ████████████████, and the DigiBox secure container. All these components are available in ██████████████ and can be adapted for the EMD trial with some modifications. The rest of the components shown will have to be developed, although not all of them will be required to start the trial.

The selected EMD content elements will be encoded in the chosen EMD formats. The content elements may include music and associated video, graphics and text. Due to an anticipated small volume of the content, content elements will be managed and tracked manually (in the later stages of the EMD system a specialized asset management system will be needed). Using the Layout and Modeler tools from █████████, the content elements will be arranged for packaging into DigiBoxes. In addition to the content itself, the rights/offers information and the rendition data (including EDL playlist and associations) will be packaged. When retailer(s) join the pilot, their offer(s) will be included and they will be provided with the appropriate HTML reference. A number of possible offers from ████████████████ library will be exercised during the pilot.

The exact structure of the EMD DigiBox will need to be defined more precisely; it is assumed that all the rights information will be encrypted, while the actual multimedia content will be interleaved and only some of it will be encrypted. Note that in the pilot the secure containers will be pre-packaged in the Production Systems with the ████████████████████ tool (which will use the local IRP). In the later stages of the EMD system some or all of the packaging may be done in the Delivery Service.

After the EMD material is prepared, it will be formatted for the EMD (by the Formatter which will need to be developed for the pilot) and staged in the Pilot Distribution Infrastructure. The content description will be provided to the Content Catalog and the Reference Server, while the business rules (offers) will be sent to the Reference Server. It is assumed that these data will not utilize DigiBoxes, but will use secured links (e.g., SSL). In the initial pilot implementation the Content Catalog and the Reference Server can be combined into a single entity managing multiple directories. The X.500 technology is the assumed choice for these directories, e.g., the DXserver from OpenDirectory, Pty Ltd. The DigiBoxes with the content and business rules will be sent to the Delivery Servers. Initially, there may be a single Delivery Server; at the later stages we anticipate multiple Delivery Servers with the Resource Manager layer above them performing load balancing, optimization and multicasting assignments.

Prior to being able to download the EMD content, the pilot users will have to acquire the applications software. The player and the IRP will be downloaded from the Deployment Manager (while it is shown as a separate entity, during the pilot it will probably be collocated with the Financial Clearinghouse (FCH) under the ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮). Once the applications software has been downloaded, the user can establish an account with FCH. Communication between the player and the FCH will utilize DigiBoxes and ▮▮▮▮▮▮▮▮▮▮▮▮▮▮. While ▮▮▮▮▮▮ will provide a front end for the FCH, limited FCH transaction and payment processing capabilities will have to be developed for the pilot. It is assumed that the FCH will not be able to connect to the UMG's back-office systems during the pilot (nor is it really necessary); instead, transaction and usage reports will be provided via "sneakernet" in the electronic and paper formats. Once an account has been established, the user can start transacting with the EMD system.

While it is possible to start the pilot with a rudimentary player application based on the modified ▮▮▮▮▮▮▮ player, it is crucial to start testing the actual EMD player application as soon as possible. Thus, it is recommended that a player application be developed for the pilot. In addition to interacting with the FCH and the IRP, the player application should be able to process HTML references from the Retail Web Sites and from other users, search the Content Catalog for references, receive content via super-distribution, request reference resolution from the Reference Server, and manage real-time content playback.

Some assumptions for the pilot configuration:

Pilot Production Systems – two (2) 400+ MHz Pentium II PC's with 15+Gb storage each

Content Catalog / Reference Server – one (1) 300+ MHz Pentium II PC with 10Gb storage

Delivery Servers - two or more 400+ MHz Pentium II PC's with 15+Gb storage

Resource Manager - one (1) 300+ MHz Pentium II PC with 10Gb storage

Consumer - 200+ MHz Pentium II or Pentium MMX PC with 4Gb storage

Deployment Manager - one (1) 300+ MHz Pentium II PC with 10Gb storage

Financial Clearinghouse - one (1) 300+ MHz Pentium II PC with 10Gb storage.

The critical path elements in the pilot development are (in the order of importance): 1) the player development, 2) the clearinghouse development, and 3) the reference process implementation. ▮▮